

Drought Preparedness Study

Completed (Seattle District) A drought preparedness study was conducted for the Cedar River and Green River basins. The DPS was one of five regional case studies managed by the U.S. Army Corps of Engineers as part of the National Study of Water Management During Drought. The goal of the national study is to improve the way Americans manage water during droughts. The overriding goal of the DPS is to leave the basins better prepared to respond to drought conditions, through development and test of a variety of drought preparation and response strategies. In the context of the 1987 and 1992 droughts, tactical alternatives being considered by the DPS study team include adoption of a computer simulation model for use to support decision making, to aid in negotiating water management issues during drought; revision of agency drought contingency plans; adoption of interagency coordination guidelines; and development of indexes based on snow and precipitation observations to predict the onset and progression of drought conditions. The study was completed in 1993 and has served as a vehicle to promote a greater regional focus on drought related, water supply problem solving, and to enhance interagency coordination, collaboration, and decision making.

Green and Duwamish Rivers and Duwamish Waterway

Completed Flood Damage Reduction and Navigation Feasibility Study; Multiple Purpose Storage Study, Underway; Duwamish Navigation Improvement, Preconstruction Engineering and Design, Deferred (Seattle District) A flood control study of the Green River and a navigation study of the Duwamish Waterway were combined, and a water supply study initiated. The flood control portion of the study involved investigating the need for improving the existing Green River levee system. The study, sponsored by King County, was completed in 1983. No levee improvements were recommended. The navigation portion of the study considered deepening of the East and West Waterways, and deepening and widening the Duwamish Waterway. The final Feasibility Report and Environmental Impact Statement were completed in January 1983. Navigation improvements of the waterways were recommended. Seattle District initiated preconstruction engineering and design studies in October 1984 following receipt of congressional funding. Construction of the project was authorized by Congress in PL 99-662; however, PED was deferred in 1986 at the request of the Port of Seattle, the local sponsor. The storage study is considering raising the summer pool at Howard A. Hanson Dam to provide water for the city of Tacoma, hydropower, and stream enhancement. The project's ability to provide flood protection would not be reduced. The study, sponsored by the city of Tacoma, was initiated in 1989 with a favorable reconnaissance study, and has proceeded into a 7-year feasibility study. Studies are scheduled to be completed in 2001. In 1995, a reconnaissance study was initiated on ecosystem restoration in the Duwamish/Green River Basin. The reconnaissance study investigated 54 restoration sites throughout the basin. King County is the sponsor of the study and the study went into the feasibility phase in late 1997 and is scheduled to be completed in fiscal year 2000.

West Seattle Freeway Bridge Replacement Project

Completed (Seattle District) At the request of the mayor of Seattle, through a cooperative agreement with the city, the Corps' Seattle District managed the construction of the West Seattle Freeway Bridge replacement. The \$150 million project, which began in November 1980, was dedicated in July 1984.

Seattle Harbor

Completed Navigation Project (Seattle District) Seattle Harbor's chief anchorage is Elliott Bay, an arm of Puget Sound. The Corps maintains three waterways at the southern end of Elliott Bay. The East and West Waterways parallel Harbor Island, a large, reclaimed area at the mouth of the Duwamish River. Both channels are 34 feet deep. The East Waterway extends from the pierhead line in Elliott Bay to Spokane Street. The West Waterway stretches from the bay to the Duwamish Waterway, with a turning basin at their junction. The Duwamish Waterway is a continuation of the West Waterway, extending about 5 miles upstream. The Duwamish Waterway was completed in 1931, except for a settling basin originally planned for the upper end. The basin was deauthorized by the Water Resources Development Act of 1986 (Section 1002). Federal costs through September 1998 were \$170,335 for new work and \$12,402,872 for maintenance. In addition, \$69,333 in contributed funds was spent for new work and \$94,475 in contributed funds was spent on maintenance. Commerce in 1997 totaled 26,564,000 tons.

Shilshole Bay

Completed Navigation Project (Seattle District) The small-boat basin at Shilshole Bay is north of the entrance to the Lake Washington Ship Canal. It is one of the best and largest small-boat harbors on the West Coast, with a capacity for about 1,600 pleasure and fishing craft. The Port of Seattle provided a concrete bulkhead, parking areas, moorage facilities, utilities, a boat launching ramp, and restaurant. The basin is protected by a rock breakwater 20 feet high and 4,400 feet long. The Corps of Engineers completed dredging in 1958 and breakwater construction in 1961. A dumped-rock extension of the bulkhead was constructed by the city of Seattle to protect a large filled area on the north and to provide additional parking space. Federal costs for the project were \$2,590,091. Local interests have spent more than \$8.5 million on the project.

Seattle Harbor_Elliott Bay Seattle

Study Terminated (Seattle District) This study was to determine feasibility of constructing a small-boat basin in Elliott or Shilshole Bays, adjacent to downtown Seattle, West Seattle, Magnolia, and Ballard. Detailed studies were started on a 600-boat marina at the West Seattle site and, in 1979, the city of Seattle and the Port of Seattle elected to proceed under a Section 107, 1960 River and Harbor Act continuing authority. Feasibility studies, initiated in 1979, were terminated in 1981 at the request of the city and the port due to their inability to meet local cost-sharing requirements of the breakwater needed for the project. The project was terminated December 17, 1987.

Floating Breakwater Prototype Program

Completed Test Program (Seattle District) In August 1982, two experimental prototype floating breakwaters were installed in Puget Sound off West Point as part of a test program to find economical and efficient methods of protecting possible boat moorage sites with only moderate natural shelter from wave action. Seattle District personnel designed two structures, which were built under contract. The concrete structure was 16 feet wide, 150 feet long, and 5 feet high; the rubber tire breakwater was 45 feet wide and 100 feet long. Tests were designed to determine the effects of wind and boat-generated waves on the breakwaters, to find optimum construction materials, and to determine the safest and most economical means of connecting fendering and anchoring structures. Monitoring was done by contract. Tests were completed in January 1984. The project cost was \$1,807,000. Of this, Seattle District expended \$1,461,590. The concrete units were subsequently installed in the Friday Harbor Small-Boat Basin project. Information from the program is available to public agencies and private developers and will also be used on Corps small-boat basin projects around the country.

Lake Washington Ship Canal and Hiram M. Chittenden Locks

Completed Navigation Project (Seattle District) The Lake Washington Ship Canal, about eight miles long, connects Puget Sound and Lake Washington. Pleasure craft, commercial barges, fishing, and oceanic research vessels navigate the locks, which is one of the busiest in the Pacific Northwest. About 195 wharves, piers, and landings border the canal, the Salmon and Portage Bays, and Lakes Union and Washington. Completed in 1916, the project was added to the National Register of Historic Places in 1978. From deep water in Puget Sound, a channel 34 feet deep and 300 feet wide extends through Shilshole Bay to the Hiram M. Chittenden Locks. Both locks are toll-free and operate 24 hours a day. The large lock is 80 feet wide and 825 feet long; the small lock is 28 feet wide and 150 feet long. A gated spillway dam extending from the small lock to the south shore controls water outflow from the canal and lakes. The authorized channel upstream from the locks is 30 feet deep. Original construction costs of the project amounted to \$3,572,018. In addition, the state of Washington spent \$246,567 and King County \$742,071 to excavate the channel upstream from the locks to construct concrete revetments on both sides of the Portage Cut. Total operation and maintenance costs through September 1998 were \$129,938,255. Commerce in 1995 totaled 1,555,000 tons. Annual vessel cargo through the locks and in the canal average over 2 million tons. Over 1.5 million people a year visit the locks, which are open year round. The project master plan to guide future use and to develop and manage project resources - originally completed in 1978 - was updated in 1994. A waterside trail along the Montlake Cut was completed in January 1971 at a cost of \$95,068. The 1,200-foot crushed rock trail includes observation decks and a fishing pier. A seven-acre botanical garden adjacent to the locks is one of the area's main attractions. The garden, named for Carl S. English, Jr., who devoted much of his life to developing the grounds, contains trees, flowers, and shrubs from all parts of the world. Reconstruction of the fish ladder, at a cost of \$3.2 million, was completed in June 1976. A below-ground-level viewing room provides the public a unique opportunity to

water migrating fish. A regional visitor center, designed to acquaint visitors with the Lake Washington Ship Canal Project and the national mission of the Corps, was opened in November 1977. The center is housed in a two-story remodeled building formerly used as a carpenter and blacksmith shop. This building also contains a bookstore. Renovation of displays was completed in FY '96. Cost of the project was \$293,905. The Corps and the city of Seattle signed an agreement in August 1976 to share equally in the construction of the six-acre Commodore Park located on West Commodore Way, just west of the fish ladder. The cost-sharing contract was the first of its kind for the Seattle District under authority of the Federal Water Project Recreation Act of 1965. Total project cost was \$1.3 million. The park was dedicated July 2, 1978. The Commodore Park/Fish Ladder project has received seven awards for design excellence, including the 1979 Chief of Engineers Honorary Award for Landscaping. The Seattle District also entered into a recreation cost-sharing agreement with the city of Seattle for the construction of the Fremont Canal Park, which features a 2,000-foot pedestrian walkway and one overlook. It is located on the north side of the Fremont Cut, adjacent to the city of Seattle's Burke-Gilman Trail. Most elements of the original Lake Washington Ship Canal have been in operation since 1916. Rehabilitation of project elements are on-going. Rehabilitation of upstream service and guard gates on the large lock were completed in 1985, at a cost of \$7,465,230. Rehabilitation of the large lock gate operating machinery is underway and will be completed in 1999.

Locks Smolt Passage Study

Project Modification, Completed. Section 1135 (Seattle District) Project completed in 2000 consists of four removable smolt slides to provide a migration outlet for juvenile salmonids over the spillway near the fish ladder; the use of strobe lights to startle smolt away from the large lock filling culvert entrance. and the removal of barnacles within the lock filling culverts. The project cost approximately \$2.35 million. King County and Seattle Public Utilities were the local sponsors.

Lake Washington Ship Canal Basin

Restoration General Investigation Study, Underway. (Seattle District) In 1992 the City of Seattle requested a reconnaissance study under section 216 to evaluate water conservation at the locks for municipal/industrial water supply. The study was curtailed because of water right issues on the Cedar River. In 1997 the City of Seattle and King County requested reinitiation of the study to consider water conservation for fishery benefits and to consider environmental projects throughout the greater Lake Washington basin. In 2001 the feasibility study was split into two interim report phases. Phase 1 recommends habitat restoration projects within the Sammamish, Cedar, and Lake Washington basins and is sponsored by King County. The feasibility is scheduled for completion in 2008. Phase 2 focuses on restoration needs in the Ship Canal, Chittenden Locks, and Shilshole Bay. It is scheduled for completion in 2010 and is sponsored by Seattle Public Utilities.

Kenmore Commercial Navigation Channel

Completed Small Navigation Project (Seattle District) Approved in 1980, dredging of a commercial navigation channel 100 to 120 feet wide and 15 feet below low lake level at the north end of Lake Washington was completed in 1981 at a cost of \$946,000. King County is the project sponsor. In 1988 traffic totaled 633,792 tons. Operation and maintenance cost through September 1998 was \$923,572. Estimated commerce in 1993 totaled about 900,000 tons.

Thornton Creek

Project Modification, Completed. Section 1135 (Seattle District). Habitat restoration project at Matthews Beach, on Thornton Creek in Seattle. Seattle Parks and Recreation Dept. is the local sponsor and owner of the park, which includes the project site. Total project cost was \$514,000.

Lincoln Park

Completed Small Beach Erosion Control Project (Seattle District) Approved in 1986, beach protection measures to alleviate coastal erosion problems at Lincoln Park beach in West Seattle were completed in 1988. This project includes 250 feet of rock revetment and 2,550 feet of sand and gravel beach nourishment and is sponsored by the city of Seattle. Through September 1998, federal cost for new work was \$925,500 and non-federal cost was \$391,126. The first renourishment was completed in 1994.

Green and Cedar Rivers

Completed Urban Runoff and Basin Drainage Study (Seattle District) An urban runoff and basin drainage study has been completed as part of an Environmental Management Program by the Municipality of Metropolitan Seattle (METRO) for the Cedar River/Lake Washington and Green River Basins in King County. The Environmental Management Program addressed water pollution, land use, water resources, urban drainage, solid waste, and air pollution problems. The study assessed impacts of storm water runoff and urban drainage on quality and quantity of natural receiving waters and drainage systems, based on alternative land uses as prepared by the Puget Sound Governmental Conference. Started in 1972 and completed in 1974, the study made specific recommendations for institutional and policy formulations, facility construction, and priorities related to urban area drainage requirements. The investigation was completed under the Puget Sound and Adjacent Waters Comprehensive Study authority.

Lower Green River _ Tukwila

Small Flood Control Study Completed (Section 205) (Seattle District) In 1988, King County and the city of Tukwila requested a study to consider upgrading levee protection at Tukwila along the Green River. The project would provide Standard Project Flood protection to a portion of the city of Tukwila. Construction was completed

in May 1992, with the total federal cost for new work totalling \$912,000 and non-federal cost totalling \$120,518. City of Tukwila has operation and maintenance responsibilities.

Green River Streambank Protection

Completed Demonstration Project (Seattle District) Authorized under the Streambank Erosion Control Evaluation and Demonstration Act of 1974, the project involved resloping 2,000 feet of eroded embankment along the Green River near Kent, WA. Riprap was placed below ordinary high water, and four varieties of shrubs and grass were planted on the slopes to provide erosion resistance. Constructed in 1980, the project was monitored to evaluate its performance as a suitable, cost effective bank protection alternative. Total cost of this project came to \$489,320. Another \$9,000 was spent in fiscal year 1982 for rehabilitation work. Periodic monitoring and maintenance has been accomplished since. King County is the local sponsor.

Horseshoe Bend, Green River

Completed Flood Damage Reduction Study (Seattle District) In 1990, King County requested a study to consider improving the right bank levee from approximately river mile 24.4 to river mile 25 near Kent, Wash. The local sponsor was the Green River Flood Control Zone District. The project was completed in late 1996, and now the levee along the Horseshoe Bend reach of the Green River provides protection from flooding up to and including the standard project flood. Construction costs through September 1998 were \$204,989 federal and \$9,146 non-federal. This project was fiscally completed in 1997.

Duwamish River, Turning Basin 3

Project Modification, Section 1135 (Seattle District) In 1995, King County requested a study to investigate potential habitat improvements along Hamm Creek, which empties into the left bank of the Duwamish River near a reach of the river called Turning Basin #3 (at approximately rivermile 6.2). The Corps began a Section 1135 habitat restoration study, and the final feasibility report was completed in July 1998. The report recommended that lower Hamm Creek be restored by improving a little over 2,000 linear feet of stream corridor, creating nearby freshwater wetlands, planting shrubs along the new stream corridor, and creating about one acre of estuarine land on the left bank of the Duwamish River. In all, about 6.2 acres of land would be needed for the project, and the total project cost was estimated to be \$3,353,000 (which includes the plans, specs, and real estate costs). The plans and specs phase began in late 1998, and construction is estimated to begin in July 1999 and be completed by December 1999.

Cedar River

Completed Flood Damage Reduction Project (Seattle District). Section 205 Flood

Control Study completed in 1999 for the lower 1.5 miles of the Cedar River in Renton. The project is to provide flood protection to the city of Renton's municipal airport and downtown industrial area, which includes the Boeing 737 assembly plant. The project includes dredging and construction of levees and floodwalls on both banks for the lower 1.5 miles of the river. The city of Renton is the local sponsor. Construction costs were \$8,174,000: \$5,000,000 federal and \$4,442,000 from the local sponsor with \$964,000 in value for lands easements, rights-of-way, relocations, and disposal areas (LERRD).

Cedar_Green River Basins

The Cedar-Green River Basins, in east-central Puget Sound, include the Seattle metropolitan area. Their drainage areas extend west from the Cascade Mountains to Puget Sound, about 1,200 square miles. Topography varies from level and rolling lands in the west to rugged mountains in the east. Lakes Washington and Sammamish are in the lowlands. The Cedar River drains into the southern portion of Lake Washington, connected to the Sound by the Lake Washington Ship Canal. The Green River originates in the Cascades and flows through the Auburn-Kent Valley and Seattle industrial area, discharging into Puget Sound. Climate is typical of western Washington, with cool summers and mild winters. Mean annual precipitation ranges from 35 inches in Seattle to more than 100 inches in the Cascade Mountains. Heavy snows occur in winter months.

Howard A. Hanson Dam and Eagle Gorge Reservoir

Completed Flood Control Project (Seattle District) Located in Eagle Gorge on the Green River, the dam controls floods in the lower Green River Valley, including Seattle's industrial district along the Duwamish River. The dam went into operation in November 1961. The structure has a rockfill section 450 feet long and 235 feet high, with a 675-foot-long spillway excavated in rock on the left abutment. Reservoir storage capacity is 106,000 acre-feet. The project is in the city of Tacoma's watershed and is not open to the public. The court recently authorized annual planting of anadromous fish fingerlings in the 100 miles of tributaries above the dam. Original runs were destroyed in 1912 when the Tacoma water diversion dam was constructed. No mitigation measures were taken for Howard Hanson Dam, located three miles upstream of the diversion dam, because of the absence of fish runs when it was constructed. Dam operation now involves procedures to minimize losses to the seaward migrant smolts when passing the dam. Original construction amounted to \$39,048,061. Operation and maintenance costs total \$20,468,416 through September 1998. Industrial and commercial development has occurred in the valley since construction of Howard Hanson Dam, and this impact has increased project benefits. Total accumulative flood damages prevented through September 1998

amount to \$696,843,000. Dam safety assurance work was completed in 1998 at a cost of \$1,273,515.

Cedar River

Section 205 Flood Control project (Seattle District) A Section 205 Flood Control was completed on the lower 1.5 miles of the Cedar River in Renton. The project provides flood protection to the city of Renton's municipal airport and downtown industrial area, which includes the Boeing 737 assembly plant. The project included dredging and construction of levees and floodwalls on both banks for the lower 1.5 miles of the river. A spawning channel for salmon was constructed on the Cedar for mitigation. The feasibility study was completed in February, 1998, with construction during 1998 and 1999. The City of Renton is the local sponsor. Total project costs were \$7.5 million.

Sammamish River

Completed Flood Damage Reduction Project (Seattle District) The Sammamish River channel connecting Lake Washington with Lake Sammamish (14 miles) was widened and deepened to protect adjacent farm lands from annual spring flooding. Completed in November 1966, the project was transferred to King County for operation and maintenance. The improvement has significantly reduced drainage problems. Project costs were \$2,583,536 from federal funds and \$696,923 from contributions. Flood damages prevented through September 1998 came to \$18,668,000.

Sammamish River

Completed Project Modification, Section 1135 (Seattle District) Modifications to the Sammamish River Flood Control project were constructed to provide fish and wildlife habitat features. The work provides restoration of fish and wildlife resources, including aquatic and riparian habitats. The work consisted of structural modifications including excavation of material from the side slopes of the existing channel, instream fish habitat features like large organic debris (tree trunks) and low flow deflectors, construction of an open channel and foot bridge to by-pass perched culverts, and plantings of trees and shrubs. Construction was completed in November 1994. Work was accomplished under Section 1135 of Water Resources Development Act of 1986. King County was the local sponsor and is responsible for operation and maintenance. Total project costs were \$391,233 (\$326,900 federal).

Mapes Creek

Section 1135 Stream Restoration Underway (Seattle District) Mapes Creek is a small tributary approximately 3 miles north of the mouth of the Cedar River along the major migration route for juvenile salmon migrating to the Puget Sound through Lake Washington. Mapes Creek is currently piped for the lower 2,200ft, a majority of that (approximately 1,500) within a combined sewer overflow (CSO) pipe, discharging into Lake Washington in deep water, 20 offshore of Beer Sheva Park, a City of Seattle park. The creek's piping and off-shore outlet prevents the development of a natural sediment delta and removes critical shallow water habitat and fresh water flows from the lower creek mouth for refuge for migrating juvenile salmon. The Mapes Creek restoration project will resurface the stream through Be'er Sheva park providing juvenile salmon a gently sloped shoreline, overhanging vegetation and off-channel habitat for refuge during migration.

Green Duwamish Ecosystem

Green/Duwamish River Basin Restoration. Several anadromous fisheries stocks as well as wildlife species are either listed or proposed to be listed as endangered, and this in turn affects numerous activities in the Puget Sound watershed. In addition, the effects of urbanization agriculture and historic forest practices are felt throughout the entire watershed. The Green/Duwamish basin has experienced vast changes. Urbanization of the lower watershed, filling of the estuary, construction of Howard Hanson Dam in 1962, and an extensive system of levees and revetments have led to heavy industrial and residential development of the basin. Natural habitats for fish and wildlife have been destroyed, and there are numerous opportunities for restoration work in this watershed. This restoration project is a comprehensive program for the entire Green/Duwamish ecosystem from the tidal estuaries to the spawning and wildlife habitat areas in the upper basin. This Project/Program emphasizes the restoration of critical habitat within the basin with full coordination of project design with interested federal, state and local agencies 16 Cities and tribes. Project features include reconnecting oxbows, levee removals and setbacks, placement of woody debris culvert removal and extensive riparian plantings. The project was authorized in the Water Resources Development Act of 2000. Total implementation cost is estimated to be \$195 million cost shared 65% Federal, 35% non-federal. The Feasibility Report was approved by OMB in November 2005. Construction New Start was authorized in October 2003 for the Green Duwamish Ecosystem Restoration Project Initial construction of the first restoration site occurred in late summer of 2005 (Meridian Valley Site). County and cities worked diligently with their congressional delegations to obtain the FY06 funding in the amount of \$1.8 million. These funds will be used to continue planning and design of additional sites (Site 1, Riverview Park, Newaukum Creek, Meridian Lake outlet, Olson Creek, Lones Levee and Spring brook

Creek). In addition, construction is scheduled for Site 1 and Lake Memorial Outlet. This project has the full support of King County and all the cities in the basin as well as the Muckleshoot and Suquamish Indian Tribes, the Washington State Department of Fish and Wildlife, the U.S. Fish and Wildlife Service, and Trout Unlimited, as well as numerous other local resource agencies.

Sammamish Weir

Completed Project Modification, Section 1135 (Seattle District) The weir on the Sammamish River downstream of Lake Sammamish and adjacent riparian zone was modified under Section 1135 Restoration authority. The purpose was to modify the weir to improve upstream salmon migration and to improve the river bank habitat for wildlife. The project is located in King County's Marymoor Park. Construction was completed October 1998. Monitoring will continue through 2003, with estimated costs of \$168,000 federal and \$56,000 non-federal. King County is the local sponsor.

Bear Creek

Terminated Project Modification, Section 1135 (Seattle District) In 1996, a Section 1135 Restoration feasibility study was initiated to improve the habitat of the lower mile of Bear Creek for salmon and wildlife. Bear Creek feeds into the Sammamish River at Redmond. The study, completed in February 1999, evaluated the addition of channel meanders, habitat features, and the restoration of the wetland areas. The project was terminated in 2005 without construction. The city of Redmond was the local sponsor.

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